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UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH ADMINISTRATION
BUREAU OF AGRICULTURAL AND INDUSTRIAL CHEMISTRY

REPORT OF INDUSTRIAL CONFERENCE ON CORNCOBS

Northern Regional Research Laboratory
Peoria, Illinois

February 9-10, 1953

The conference on corncobs, their processing and utilization, was opened by Mr. T. F. Clark, Chemical Engineer, Agricultural Residues Division, Northern Regional Research Laboratory.

Following a short period of self-introductions and general announcements, Dr. R. T. Milner, Director of the Laboratory, gave an address of welcome. This address included a brief description of the work and various accomplishments of the Laboratory since its establishment.

Dr. E. C. Lathrop, Head of the Agricultural Residues Division, in his account of the "Role of the Agricultural Residues Division" pointed out that profitable uses should be developed for the 250 million tons of crop residues produced annually in the United States. The false assumptions that have hindered use of crop residues, according to Dr. Lathrop, are: (1) That the residues are available at practically no cost; and (2) that substitute products prepared from the residues can compete with quality materials solely on the basis of lower cost. Dr. Lathrop emphasized that use of residues should be based on their superior performance. Surveys of residue availability conducted by the Laboratory have been instrumental in setting up commercial operations based on agricultural residues.

"Hammer Mills in Crushing Cobs" - Mr. L. F. Herman, Development Engineer, Gruendler Crusher and Pulverizer Company, St. Louis, Missouri.

Mr. Herman referred to the publication of the Northern Laboratory (AIC-336 "Dry Grinding of Agricultural Residues--A New Industrial Enterprise") as presenting a thorough discussion of the subject. Design engineers seek the advice of the Laboratory regarding product characteristics that influence the design of crushing and grinding equipment.

Of the two general types of hammer mills, (1) small diameter and high speed, and (2) large diameter and slow speed, the latter is preferred by the Gruendler organization on the basis of lower maintenance costs, greater uniformity in the product, and less heating of the product. Effective peripheral speed is essentially the same for both types of mills. Screening area in the slow-speed type is double that of the high-speed type.

Mr. Herman referred to the excellent absorptive characteristics of ground corncobs. This characteristic accounts for their use with molasses in cattle feeding. Absorbency and abrasiveness accounts for their satisfactory use in processing garbage for stock feeds. Ground cobs scour and absorb greases and oils from the interiors of pneumatic conveying systems handling hot ground garbage. Grease fires in these systems have been eliminated by mixing ground cobs, about 4 percent, with the garbage.

From his own experiences, Mr. Herman stated that cobs obtained from the field contain about 17 to 18 percent moisture. For grinding in hammer mills, the moisture content should be reduced to about 3 percent. Drying can be done effectively after crushing cobs to about 1-1/2-inch pieces.

While early demands for cob products could be satisfied by crushing, the new uses require a variety of products ranging down to No. 60 in size. The need for small-particle products has increased the necessity for aeration (removal of chaff, beeswing, and pith by aspiration). New information needed by the Gruendler and other manufacturers of grinding equipment includes: (1) The effect of recycling tailings and coproducts in preparing certain ground products; (2) new markets for ground products according to size produced without recycling; and (3) mill types for preparing products of definite physical characteristics.

Studies made by the Gruendler firm have shown that a single slow-speed mill has greater flexibility and capacity than two high-speed units with the same combined power consumption. Power requirements for grinding varied with the source and variety of cobs.

"Attrition Mills as Fine Grinders for Corncobs" - Mr. C. L. Linkinhoker, Engineer, The Bauer Brothers Company, Springfield, Ohio.

Mr. Linkinhoker stated that the problem facing his company is much the same as that discussed by Mr. Herman. That is, the firm wishes to improve its line of equipment for more efficient processing of corncobs. The basic principles and construction of attrition mills were discussed. Mr. Linkinhoker reported on results obtained with a new plate pattern for use in 36-inch mills. Yields of fine mesh products were greater than experienced previously with older plate patterns.

"Principles in Grinding Corncobs with Roller Mills" - Mr. E. E. May, Milling Engineer, The Wolf Company, Chambersburg, Pennsylvania.

According to Mr. May, processing should start with cleaning of cobs in a sheller for removal of husks, some beeswing, and residual grain. The cobs, after being broken in a Nickle crusher, are reduced further in an attrition mill. "Devil- or spike-tooth" plates are effective in reducing particles to 1/4 to 3/8 inch, as well as in loosening the major portion of the beeswing, chaff, and pith from the woody component. The chaff materials are removed in an aspirator cleaner, and the woody particles dried to about 10 percent moisture content.

The woody particles may be cleaned further after this drying or following additional grinding in a hammer mill (1/4-inch diameter perforations). This grinding in the hammer mill loosens residual chaff and beeswing as well as reducing the general size of material delivered to the "first break" roller mill. Bulk value of this material is about 28 pounds per cubic foot.

The woody particles are then ground in a progressive manner through several stands of rolls. Roll stands may be double or single, depending upon volume of material to be processed. Sifting after each reduction (or pass through rolls) is performed to recover the desired fractions. Roll corrugations vary from 6 and 8 cuts per inch in the first mill to 22 cuts per inch in the final or fifth stand. A speed differential of 2-1/2:1 is maintained on each pair of rolls. Belt slippage between roll drives will interfere with proper granulation. One purifier handles the coarse fraction, that is, No. 10/20 product, and another purifier the fine products (e.g., No. 24/50).

Should products of finer size be required, the corrugations for the later roll stands must be correspondingly finer and the sifter provided with the proper bolting cloth. Roll feeders are recommended for all roll stands except the "first break" stand where a shaker-feeder should be used.

"Experiences in Milling Corncobs" - Mr. L. H. Sentman, Miller, Pabst Brewing Company, Peoria, Illinois.

Mr. Sentman's experience as a miller of corncobs was acquired in a cob-processing plant at Circleville, Ohio, during World War II. Several grades of cob products were being prepared for cleaning and finishing ordnance materiel. Operating conditions for this plant were as described briefly in the following paragraphs:

Whole cob storage capacity was limited to 200 tons. Cobs from storage were cleaned mechanically and magnetically (belt separator) and then crushed to 3/8-inch particles in a single-disc attrition mill. Material coarser than 3/8 inch was returned from grading reels for further reduction in size. The crushed cob particles were dried and tempered 8 hours to adjust moisture content to about 3 percent before the material went to the "first break" rolls.

In all mill stands the rolls were operated with the corrugations run sharp-to-sharp and with a speed differential of 1-1/2:1. The spiral or pitch of the corrugations was 1/2 inch. Roll combinations, number of corrugations, and general conditions were comparable to those described by Mr. May. An exception was in the use of a hammer mill instead of a roller mill for the final reduction of cob particles. Magnets were used directly ahead of all mills to avoid the hazards and damage possible from tramp iron. The dust-collecting cyclone was erected outside the buildings as a safety feature. The top of the cyclone was arranged for easy, quick release in

the event of an explosion. This provision prevents serious damage to the pneumatic system. No fires were ever encountered in milling operations according to Mr. Sentman.

In the Circleville plant about 80 percent of the original cobs was recovered as salable product.

Mr. Sentman commented on power requirements as follows: 4 double stands of rolls, 100 hp.; elevators, 35 hp.; 36-inch single-disc crusher, 25 hp.; and purifiers, 25 to 35 hp. Purifiers were operated at about 500 r.p.m. An 80-bushel Cutler dryer was heated indirectly from offal used as boiler fuel. Storage space for whole cobs was calculated on the basis of 180 cubic feet per ton of whole cobs.

"<u>Classification and Grading</u>" - Mr. A. B. Dunwody, Engineer, Dunwody Engineering Company, Chicago, Illinois.

Mr. Dunwody stated that this subject is very complex and that perhaps 18 to 25 methods might be used in making separations. Each grinding process presents its own peculiar problems. Equipment manufacturers in attempting to sell separating equipment to the industry must show an improvement in quality of the product, or provide more economical means for making the separations.

With respect to the cob-processing industry, Mr. Dunwody prefers to consider the operation as separation rather than classification. Separations may be:

1. Separation according to shape,
2. Separation according to size,
3. Separation according to density,
4. Removal of magnetic materials,
5. Removal of nonmagnetic materials.

Removal of magnetic contaminants from process materials is a complete problem in itself. Pulley, drum, and plate magnets are very effective. However, depth of bed (thickness of material over magnet), and velocity of flow are factors influencing effectiveness of metal removal. The fact that intensity of a magnetic field varies inversely as the square of the distance from the poles of a magnet is overlooked too frequently in separating problems.

Nonmagnetic materials present another type of problem. Stones and similar materials can be removed on the basis of differences in weight with respect to the process materials. Aspirators, suction legs, and stoners are effective units. Economies realized by removal of stones, weevils, and other rubbish may appear intangible because the apparent value of the process material is unchanged and the refuse has no value. Where corn is removed from cobs the economies become tangible because of the profit that can be realized on the grain.

Physical character of a material influences the effectiveness of screening to size. In most screening operations the differences in density of particles have essentially no effect. Vibratory flat screens are most economical for separation of coarse particles; the gyratory or whip sifters for fine materials (minus No. 60).

Meeting the customers' requirements must be considered part of the problem of separation. The method selected must provide products in the price range the customers can afford. Gravity separators are low in cost but become ineffective if the particles to be separated have nearly the same densities.

About 20 general types of screens are available so that broad opportunity exists for selection according to job requirements. Scalping operations to remove part of one constituent of the mixture may be necessary before any one screening or separating method becomes effective. In this respect, operators or processors should gear their thinking to the abilities of the machine so as to permit the machine to operate most effectively. Do not try to make a machine do work for which it was not intended.

"Dust Explosions and Fires in Grinding Plants" - Mr. H. R. Brown, Senior Engineer, U. S. Bureau of Mines, College Park, Maryland.

Foreign materials, such as metals and stones, when present in materials to be milled constitute an explosion hazard. Explosion hazards exist in 28,000 to 30,000 industrial plants in this country. More than 90 million dollars and 800 lives have been lost as a result of dust explosions.

To be explosive, dusts need to be combustible, or readily oxidized. Thus, fine metal dusts can be as hazardous as those from coal mines, grain elevators, starch and plastics plants. Any spark may initiate a dust explosion. Dust explosions are comparable to those resulting from gases.

During the late war the price differential between magnesium metal and the dust (about $1.70 per pound) was the incentive to interest many persons in the manufacture of magnesium powder. However, many plants were destroyed by dust explosions before any profits could be realized by the operators, according to Mr. Brown.

The minimum concentration in air for explosion of most dusts is about 0.05 ounce per cubic foot. This concentration is sufficient to form a cloud that will impair visibility.

Dusts are generally classified as: (1) Carbonaceous; (2) metallic; and (3) plastics. Dusts are also grouped according to intensity of explosibility: (a) Low, or slow burning; (b) medium; and (c) high. Dusts from starch and sugar were cited as examples of dusts in the high intensity group.

Temperature for ignition of dust clouds ranges from about 400° to 500° C., while temperature for ignition of dust in layers is about 220° C. Developed pressures range from 40 to 100 p.s.i. but the greatest hazard is the rate at which the pressure builds up.1/

Tests on dusts from two components from corncobs showed the following ignition values:

	Cloud (°C.)	Layer (°C.)
Chaff components	500	220
Woody component	490	220

Sources of ignition include sparking of electric motors; electrostatic sparks, metallic sparking, and sparks from welding operations. This last source can be eliminated by performing all welding outside of the hazardous area. Ignition by sparks can be avoided by grinding in inert atmospheres or by reducing the oxygen content to 12 to 14 percent.

The initial explosion is not difficult to take care of. This is done by venting equipment to the outside of buildings. The second phase of a dust explosion is the most destructive, and poor housekeeping accounts for high property damage. Dust should not be allowed to accumulate on equipment, beams, ledges, or any place from which it can be dislodged by the first-stage explosion. Building vents should be sufficient to relieve the explosive pressure quickly without structural damage. For strong structures, vent areas should approximate 1 square foot for each 100 cubic feet of structure; for light construction, i.e., sheet metal, 1 square foot per 40 cubic feet.

All cob material finer than No. 30 is definitely explosive. Mr. Brown effectively demonstrated the combustible and explosive nature of dust from corncobs. A dust cloud formed by sifting No. 100 flour through cheesecloth was ignited by a lighted match held several feet below. Flame propagation was very rapid as with combustible gases.

Mr. Brown urged that anyone associated with dry grinding acquaint themselves with the codes established by the National Board of Fire Underwriters and the National Fire Protection Association.

Afternoon Session, February 9

Mr. E. J. Whisler, Barnard and Leas Manufacturing Company, Inc., Cedar Rapids, Iowa, made brief comments regarding use of small buhr mills and their versatility because of individual drives and low-power requirements. Although plate wear and replacement is high for fine grinding of

1/ The data presented by Mr. Brown were taken from the U. S. Bureau of Mines report "Explosibility of Agricultural Residue Dusts" (No. 3254, Project No. PX4-1, June 26, 1952). The 17 dusts used in the investigation were furnished by the Northern Laboratory.

cobs, service on coarser breaks is good. Mr. Whisler referred to the Northern Laboratory publication on dry grinding for typical results that could be anticipated with buhr mills. He stated also that attempts are being made to build larger units of the same type for greater unit capacity.

Mr. K. R. Sterrett of Sprout, Waldron and Company, Muncy, Pennsylvania, commented that manner of processing cobs depended upon end use, and that replacement costs were influenced by end-use requirements. The over-all capacity of roller mills, according to Mr. Sterrett, compensated for the greater cost of roller mill installations as compared with attrition mills. Shape of product particles can be controlled by proper operation of the mills. Mr. Sterrett continued with a consideration of rotary knife cutters. The cutters do an excellent job breaking cobs into particles 1/4 to 1 inch in size, but capacity is not adequate for continuous operation. Stones and materials that can damage knife edges must be kept away. Less heating of the cob particles occurs with rotary knife cutter than with attrition mill. Husks present no problem during reduction of cobs with the rotary cutter.

Mr. Clark presented slides of tables and maps showing the estimated production of corncobs in the several states of the Corn Belt. Mr. G. Seeds, cob buyer for The Quaker Oats Company at Memphis, Tennessee, commented that the data presented in the tables and maps were consistent with their experiences and estimates. Time of accumulation and shipment of whole cobs for furfural manufacture is influenced by the Government's corn-sealing program. The Quaker Oats Company is able to obtain all the corncobs its furfural plants can accommodate without plant expansion. The plants operate 24 hours per day, 7 days per week.

Mr. W. V. Karr, Agri-Indus Manufacturing Company, Columbus, Ohio, stated that it was his opinion that cob-processing operations must be kept simple to keep expenses at a minimum. Further, processors should do experimenting to obtain the best product characteristics with their equipment. Mr. R. E. Steinfort, Mt. Pulaski Products, Mt. Pulaski, Illinois, interrupted with a question on how to improve sifter efficiency. Mr. Dunwody advised that flowability of material, character of the sifter wire, sifter knockers, least particle diameter, and particle trajectory should be considered. A processor should realize that size of screen openings should be consistent with the size of particles he wishes to obtain. When comparing results of sifting with laboratory sieve tests, the laboratory method should be specified.

Dr. Lathrop discussed at length particle shape and size with respect to need for product specifications. For applications requiring very coarse cob particles, specifications are not critical. However, for industrial applications requiring products of special characteristics, there is need for more specific details in purchasing to avoid use of improper materials. Improperly selected materials and methods often cause condemnation of cob products and of the cob industry in general.

Difficulties encountered at Rock Island Arsenal in cleaning electric motors with improperly specified cob grits and poorly chosen conditions were cited as an example. The prompt service of the Northern Laboratory corrected this unfortunate situation. The distinction in properties of products from roller mills and attrition mills was pointed out. This brought forth a question as to whether specifications would be based on type of grinding equipment. Specifications should not distinguish between mills (or method of production), but rather between physical properties needed in the products. If roller mills can produce particles having the same general shape as particles from other mills the use of roller mill products should not be restricted. Dr. Lathrop continued with an account of the development of the soft-grit blast method using corncobs for the Navy. Specifications covering particle shape of the soft grits, Dr. Lathrop pointed out, were in accord with results of tests by the Navy.

Mr. Steinfort stated that his firm in supplying soft grits to the railroads furnished a "No. 10" grit although "No. 20" was specified. Is the consumer, then, actually acquainted with his specific requirements? Mr. R. S. Robertson, Ewing Mill Company, Brownstown, Indiana, asked if any relationship existed between particle size and hardness. Dr. Lathrop pointed out that density of the particle is a factor that influences hardness.

Mr. Dunwody agreed with Dr. Lathrop regarding the need for sound specifications with respect to what the processors can produce rather than what they hope to produce. Mr. Dunwody continued with a discussion of why granular materials, instead of elongated or sliver-like particles, are needed for blast-cleaning jobs.

Dr. Lathrop suggested that the processors cooperate with the Laboratory in supplying representative samples of finished cob products for physical tests. Results of these tests would serve as the bases for specifications covering the various grades and products. Sample products under study would be coded and classified according to physical characteristics so that processors' identity would remain confidential. Cooperating processors would receive a complete report of results of the investigation.

Mr. Sterrett explained that product characteristics resulting from other methods of grinding could be duplicated with roller mills. Conditions for milling with rolls, that is, roll corrugation, spiral, number of cuts, differential speed, and roll clearance, must be considered in order to duplicate product characteristics.

Mr. Herman commented on the problem of specifications by citing the experiences of the wood-flour producing industry as an example. Only after the end product is adequately defined can processors hope to meet consumers' requirements. According to Mr. Herman, the Northern Regional Laboratory with its experience and facilities is in the best position

to establish uniform specifications for given jobs. The processor then has the responsibility to educate the consumer as how best to use the products. The processor must select equipment that will permit preparation of material meeting the specifications. One processor stated that his concern was only in moving cob products and not in product specifications.

Dr. Lathrop explained that a policy of permitting a single consuming group to set up specifications for the cob-processing industry hindered expansion of the entire industry. Specifications that might be developed as a result of the Laboratory's studies would be of benefit to both producers and users of cob products. Development of simple testing procedures whereby products would be evaluated on comparable bases would be one aim of the Laboratory's investigation. Any specifications that are developed should be reviewed by the processor and his customers together in order to promote a better understanding of the applications and the limitations for cob products.

Apparent specific gravity of cob components was discussed by Mr. Clark. Specific gravity values were least (0.860) for pith and increased progressively through woody material and chaff to the maximum (1.470) for beeswing. The fact that there was no sharp distinction in specific gravity of particles produced by hammer-mill grinding under normal production conditions accounts for some of the separating problems encountered by processors. Mr. Dunwody commented that when the various factors involved are considered that gravity separation of crushed cob particles probably would be the most effective method for separating the components.

A question regarding the most effective speed at which to operate a purifier was answered by Mr. May who stated that 525 r.p.m. was about optimum. Cleaning of purifier screens could be facilitated by the use of nylon brushes.

Dr. Lathrop summarized the situation regarding specifications by stating that only problems of general over-all interest to the industry could be considered, and that the Laboratory could not act as a commercial consulting laboratory that could study any and all problems associated with a product or products.

<u>Tuesday, February 10</u>

"<u>Military Uses for Corncobs</u>" - Mr. L. E. Frye, Chief Chemist, Remington Arms Company, Inc., Lake City Arsenal, Independence, Missouri.

Mr. Frye explained the uses made of corncob grits in the manufacture of small arms ammunition at Lake City Arsenal. This arsenal is government-owned, contractor-operated, and all production is at the request of the Department of Defense. Principal uses for corncob grits include: (1) Oil-removal from cartridge case stampings; (2) paint and lacquer-removal

with hydrocarbon solvents; and (3) acid etching for surface finish. The operations described were for ammunition for 30-caliber carbines although the operations were much the same for other caliber ammunition.

The operations involving corncob grits are batchwise, the grits being used only twice before being discarded. (This practice might have resulted from experiences with poorly selected grits.) The operations are performed in tumbling-barrel type equipment (Ransohoff). Durable cob particles are required to resist breakdown into objectionable fines and dust. The fines and dust prevent proper sealing between the primer and the case and between the case and the bullet. Deterioration of ammunition by moisture then becomes possible. The slim, sharp-pointed cob particles obtained in some milling operations are less satisfactory than granular materials because of their tendency to break.

For etching treatments, about 2 pints of 5 percent phosphoric acid is added to 25 pounds of cob grits.

Although the cost of granular cob products was about $2 per ton greater than for sliver-like particles, the use of granular material actually resulted in a saving of $1,000 per month. Mr. Frye stated that the Northern Laboratory had aided the Arsenal in pointing out pertinent characteristics that should be considered in specifications. These had been omitted from previous purchase specifications so that duplication of purchase was not possible.

"<u>Corncobs in Beef Cattle Feeding</u>" - Mr. E. F. Dickey, Vice President and General Manager, Feed and Milling Division, Honeggers' and Company, Inc., Fairbury, Illinois.

Following brief references to the historical background on feeding corncobs to beef cattle, Mr. Dickey discussed the value of corncobs in cattle rations based on results experienced on the Honeggers' test farm. The investigations include over-all feeding until the cattle are ready for the market. In the particular study cited, shelled corn used in finish feeding was fed in quantities of 6 and 12 pounds per day. The conditions and results of this test are summarized in the following table.

Conditions and Results of Tests on Feeding Cob-base Rations to Beef Cattle[2/]

Growing phase--100 days--Fall and Winter, 1951-52.

Ground corncobs, lb./day	15.21
Special supplement, lb./day	3.47
Daily gain, lb.	1.57
Cost per lb. gain, cents	17.18

Finishing phase--120 days--Spring and Summer, 1952.

	Lot 1	Lot 2
Shelled corn, lb./day	6.36	11.28
Ground corncobs, lb./day	14.42	13.77
Special supplement, lb./day	3.50	3.50
Daily gain, lb.	2.17	2.45
Cost per lb. gain, cents	21.65	25.40

Over-all results--220 days total

	Lot 1	Lot 2
Feed cost per lb. gain, cents	19.94	23.10
Starting weight, lb.	788	788
Finish weight, lb.	1199.5	1233.6
Dressing yield, percent	60.75	61.50
Market grade: Prime	-	40
Choice	55	60
Good	22	-
Common	22	-
Feed cost per steer, dollars	83.44	104.55
Gross price per steer, dollars	389.83	407.08
Profit, above feed cost, dollars	306.39	302.53

2/ Cost data are based on corn at $1.79 per bushel; ground corncobs at $10.00 per ton and the special supplement, $112.40 per ton.

Although the market grades obtained with 6-pound corn finish ration were inferior to those obtained with the 12-pound corn finish ration, the feeding profit was greater when the lesser amount of corn was fed.

Mr. Dickey speculated on the value of using hay crop land as additional corn land. The corn could produce more pork and the cobs more beef. The economics would be based on the following:

(1) Five bushels of corn produces 100 pounds pork;
(2) One acre yields 100 bushels of corn;
(3) One acre is worth $350 as live pork when live pork is worth $17.50 per cwt.
(4) Thirty acres would produce $10,000 worth of pork (from corn) and 3,600 pounds of beef from 36,000 pounds of cobs.

According to Mr. Dickey, farmers lose more through inefficiency than they realize as profit. Loss of cobs at 2 cents per pound while corn is 3 cents per pound is significant for their feeding value. Other losses that represent opportunities for improvements in agricultural practices are losses in pigs, 40 percent; calves, 20 percent; and laying poultry 25 percent.

Mr. Fred Siegrist, Great Western Corn Cob Processors, Inc., Aurora, Nebraska, gave a brief account of his experiences in feeding cob rations to beef cattle. The operations at Aurora consist primarily in beef cattle feeding. Only the offal (pith, chaff, and beeswing) separated from crushed woody particles is used. Blackstrap molasses plus other supplements in accord with Purdue supplement A formulation is used. Gains as great as 2.2 pounds per day have been experienced. Feed costs were 18 cents per pound of gain. This was for growing only and did not include finish feeding which was done by other feeders. According to Mr. Siegrist, 30 minutes per day for two men is ample time for feeding 700 head of cattle.

Mr. R. S. Robertson stated that corn shucks fed with Purdue supplement A were giving good results.

Dr. H. H. Hall of the Feeds and Vitamin Section, Fermentation Division, raised the question as to why corncobs appeared so effective in feeding when their nutrient values such as protein were so low. Presence and distribution of various vitamins in corncobs were discussed. Perhaps corncobs contain beneficial substances not yet identified, or crushed corncobs furnish a surface that favors growth of bacteria occurring in the rumen of the cattle. However, much remains unknown about the mechanics of nutrition by corncobs.

Color slides of the construction of a cattle feed plant were shown by Mr. A. L. Ward, McLaughlin, Ward and Company, Jackson, Michigan. This plant was built for the Crow Hybrid Corn Company, Milford, Illinois, to use the corncobs obtained from shelling of hybrid seed. All feed prepared

at this installation will be used in feeding cattle at this plant only. Crushed cobs are prepared by reduction in a 20-inch hammer mill powered by a 100-hp. motor. Blower fan is operated by a separate motor. Rated capacity of the mill installation is 4 tons of cobs per hour with a 3/8-inch screen in the hammer mill. The entire installation is highly mechanized to minimize the hand-labor in preparing the cob rations.

Known uses for cob products and specifications with respect to particle size and other characteristics were discussed by Mr. Clark. From comments made by Mr. Karr, it was apparent that some processors were not aware of the broad specifications for cob products used by furriers. Particle size ranges from No. 10 to No. 100 but requirements of the individual furriers are much more restrictive. Carriers and diluents for insecticides must be fine flours and very low in price. Classifying and grading of flour finer than No. 100 must be done with air.

Brightness of color, absorption characteristics, and fibrous nature favor the use of wood flour in plastics and adhesives in preference to cob flour according to Dr. Lathrop. Plastics manufacturers are reluctant to change formulations or manufacturing techniques. The manufacturers wish to avoid the need for additional customer servicing that might be necessary should cob flour be used in plastics and adhesives. Flour from walnut shells has been very effective; it is possible that its wax-like components aid in plastic flour. Bleaching of flour does not appear to be economically feasible.

The use of ground cob materials as conditioners for foundry sands might be worthy of consideration according to Mr. Clark. It is realized that low price is an important factor. However, the utility value of cob flour is better than that for a number of other materials including wood flours according to an article[3/] cited by Mr. Clark. Considerable discussion ensued regarding the grade of product required and the price that could be tolerated by the foundry trade. In this discussion it was brought out that flour produced from Douglas fir bark costs $50 to $60 per ton; wood flour for plastics, $45 per ton; and coarse wood flour (a No. 30 sawdust or meal), $30 per ton. Little was actually known, however, regarding the quality or the detailed specifications for these materials. Several processors suggested that the Laboratory undertake the problem of determining the specifications for a sand-conditioning grade of corncob flour, and the unit cost that the foundries could afford.

The problem of automobile undercoating compounds, their composition and filler requirements was suggested by Mr. R. S. Robertson. Dr. Lathrop stated that the Laboratory could investigate both the foundry and the undercoating use for ground agricultural residues to determine specifications and feasibility of using ground cob materials in these applications. The Laboratory, according to Dr. Lathrop, must provide the best

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3/ Barlow, T., and Loucks, C. P. Effect of cellulose materials on foundry sands. The Foundry 77: 82-84 (1949).

factual answers to the problems of both the processor and consumer of cob products. From the information supplied by those individuals attending the meeting, Dr. Lathrop estimated that 1 million tons of corncobs were now being used profitably. This estimate included those cobs used in furfural manufacture, industrial processing, feed manufacture, and as mulch and litter.

Mr. J. E. Robertson, Ewing Mill Company, Brownstown, Indiana, on behalf of the cob processors, equipment manufacturers, and others attending the conference, expressed appreciation for the service provided by the Laboratory, and particularly by Dr. Lathrop and Mr. Clark.

List of Attendance

Ackmann, L. E., Allis-Chalmers Manufacturing Company, Commercial National Bank Building, Peoria, Illinois

Albright, G., McLaughlin, Ward and Company, Mattoon, Illinois

Altorfer, E. J., Cobaloy Mills, First National Bank Building, Peoria, Illinois

Ashbrook, J. W., Baw Industries, 107 East Attica Street, Rossville, Illinois

Bowles, W., Mt. Pulaski Products, Mt. Pulaski, Illinois

Bradley, J., Peoria, Illinois

Brandt, J. T., Atlanta, Illinois

Brown, H. R., Senior Engineer, U. S. Department of the Interior, Bureau of Mines, College Park, Maryland

Burrell, J. P., Vice President, James H. Burrell and Sons, Inc., 3615 Olive Street, St. Louis, Missouri

Christ, J. H., Sullivan Grain Company, Sullivan, Illinois

Clark, A. H., Sales Manager, Polishing Products, Inc., 1200 Bayou, Vincennes, Indiana

Cyrulik, E., Mt. Pulaski Products, Mt. Pulaski, Illinois

Davis, R., Allis-Chalmers Manufacturing Company, Commercial National Bank Building, Peoria, Illinois

Dawson, W., Lincoln Chamber of Commerce, Chamber of Commerce Building, Lincoln, Nebraska

Dickey, E. F., Vice President and General Manager, Feed and Milling Division, Honeggers' and Company, Inc., Fairbury, Illinois

Dirks, E., Fancy Prairie, Illinois

Dowd, L., Dowd Oil Company, Schuyler, Nebraska

Dunwody, A. B., Engineer, Dunwody Engineering Company, 205 West Wacker Drive, Chicago, Illinois

Fisher, D. O., D and L Company, DeLand, Illinois

Fitz Henry, E., Paxton Cob Company, Paxton, Illinois

Forster, J., Production Manager, DeKalb Agricultural Association, Inc., 310 North Fifth, DeKalb, Illinois

Frye, L. E., Chief Chemist, Remington Arms Company, Inc., Lake City Arsenal, Independence, Missouri

Fulkerson, R. E., San Jose, Illinois

Gimlin, A. S., Gimlin Contracting Company, Inc., 1133 South Seventh, St. Louis, Missouri

Hammond, W. E., Department of Chemurgy, The University of Nebraska, Agricultural Experiment Station, Lincoln, Nebraska

Herman, L. F., Development Engineer, Gruendler Crusher and Pulverizer Company, 2915 North Market, St. Louis, Missouri

Hodel, R. I., Roanoke, Illinois

Johnson, W. M., Buyer, The Quaker Oats Company, Omaha, Nebraska

Jones, C. E., General Manager, Jones Land and Cattle Company, 514 West Copper Avenue, Albuquerque, New Mexico

Karr, W., Agri-Indus Manufacturing Company, 1327 Huntington Bank Building, Columbus, Ohio

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